Liquid Precipitation Retrievals from the ACR at Wakasa Bay

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Motivation : The successful application of AMSR-E products to study precipitation and its variability on global scales requires that the uncertainties in these products be rigorously determined.

Goals : Exploit the complementary nature of active and passive observations to evaluate AMSR precipitation products using airborne cloud radar data. Specifically:

- ***Physical validation:*** verify and assess the accuracy of algorithm assumptions that affect retrievals but cannot be directly measured by the sensor (eg. freezing level, sub-pixel variability, hydrometeor vertical structure).
- ***Correlative analyses:*** test the consistency of related products from independent sensors (eg. random and systematic differences in rainfall estimates).

Algorithm Summary

1. Liquid precipitation algorithm cast in optimal estimation framework
2. Accounts for Mie scattering and attenuation from hydometeors and gases
3. Freezing level inferred from reflectivity gradient and maximum associated with bright band
4. Applied to ACR data from Wakasa Bay field experiment:
   - Nadir-viewing cloud radar operating at 95 GHz
   - 120 m vertical resolution
   - ~80 m footprint at surface from 6 km altitude

Strengths

Retrieval framework provides a suite of Q.C. diagnostics and tools for error analysis

ACR sensitive to clouds and ice as well as precipitation

High spatial and resolution good for resolving BB and examining horizontal variability

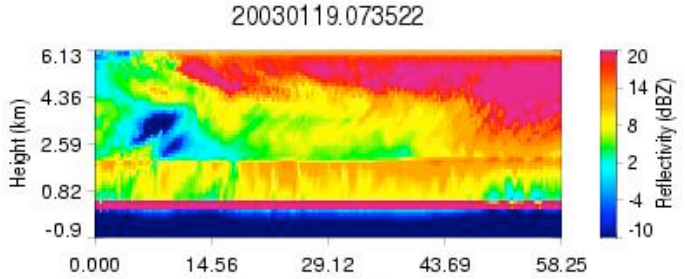
Weaknesses

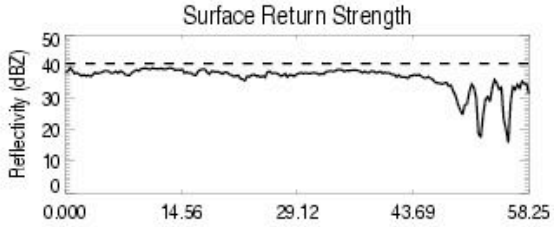
Strong attenuation at 94 GHz obscures heavy rainfall

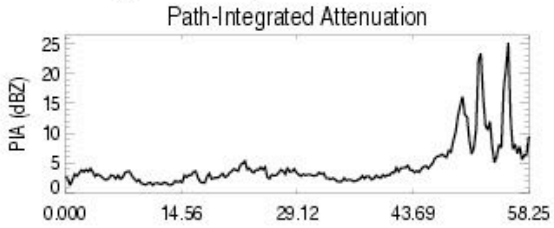
Instrument is nadir-pointing provides data across only a slice of the AMSR footprint

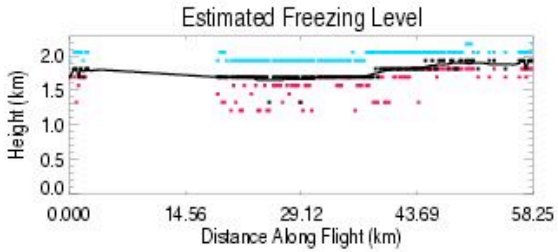
Single frequency method limits information on dielectric properties of melting layer and DSD

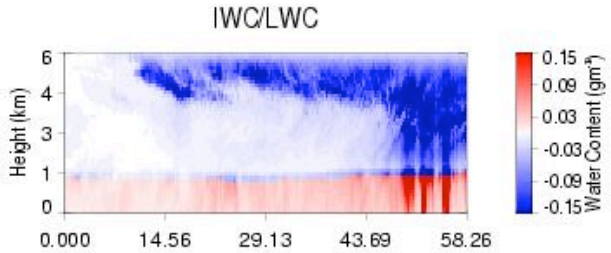
Case 1: Jan 19, 2003

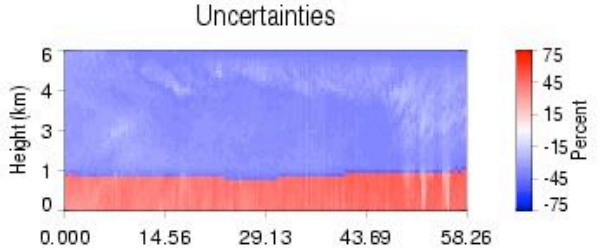


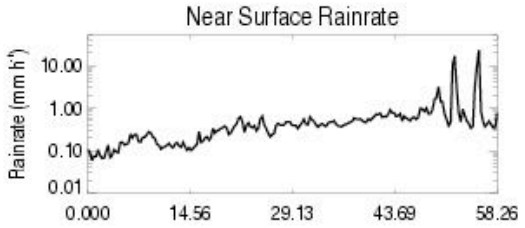


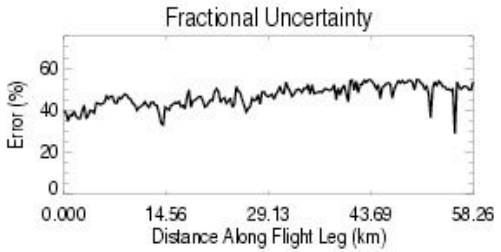




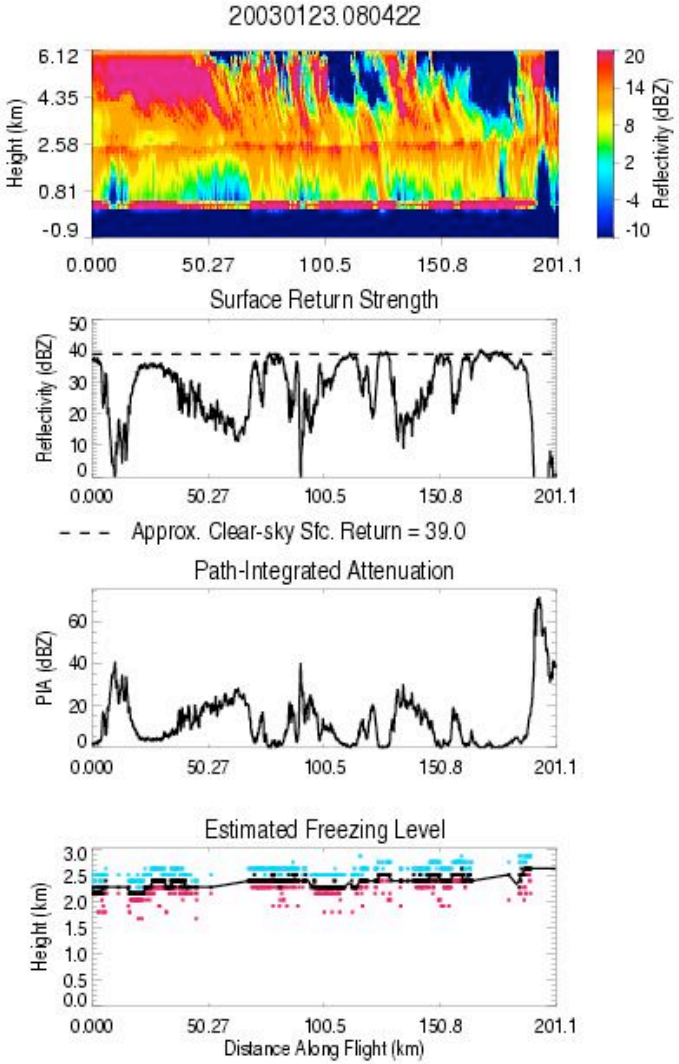


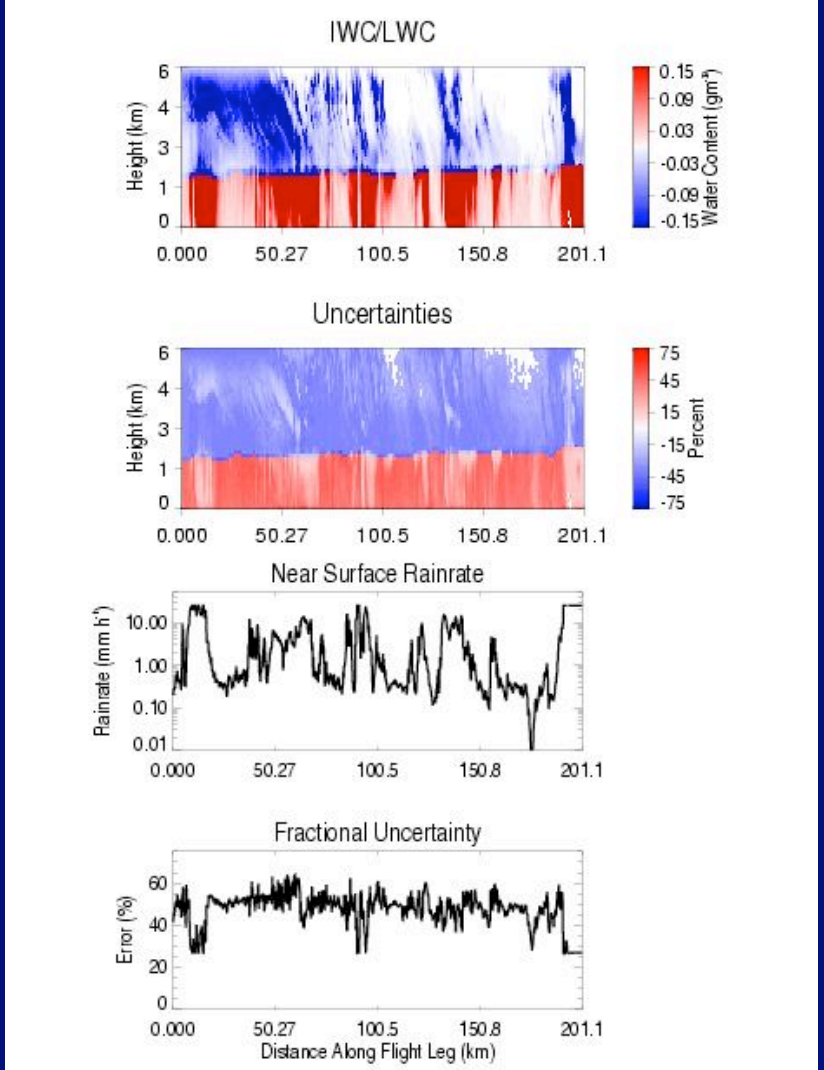






Case 2: Jan 23, 2003





What's Next?

Fine-tune algorithm: determine model errors (e.g. due to ice density, DSD, PIA, etc.), evaluate performance using diagnostics, estimate overall uncertainty in products

Evaluate results using similar products from other instruments flown during the Wakasa Bay experiment (eg. the PSR and PR2 instruments)

Develop a framework for using results to evaluate the quality of the assumptions in and products of AMSR rainfall algorithms

- Freezing level
- Sub-pixel variability (i.e. beamfilling)
- LWC/IWC profiles

} Assumptions

- Rainfall detection (i.e. at light rainrates)
- Retrieved rainfall rates

} Products